WEIRD TALES & MYTHS • ROCK POWER • NATURE'S ODDITIES • MASK DIY

Brainspace

FOR CURIOUS YOUNG MINDS 8 TO 14

A SMART & INTERACTIVE MAGAZINE

OCTOBER/NOVEMBER 2025

LAUNCH ZAPPAR TO VIEW

Best Friends forever

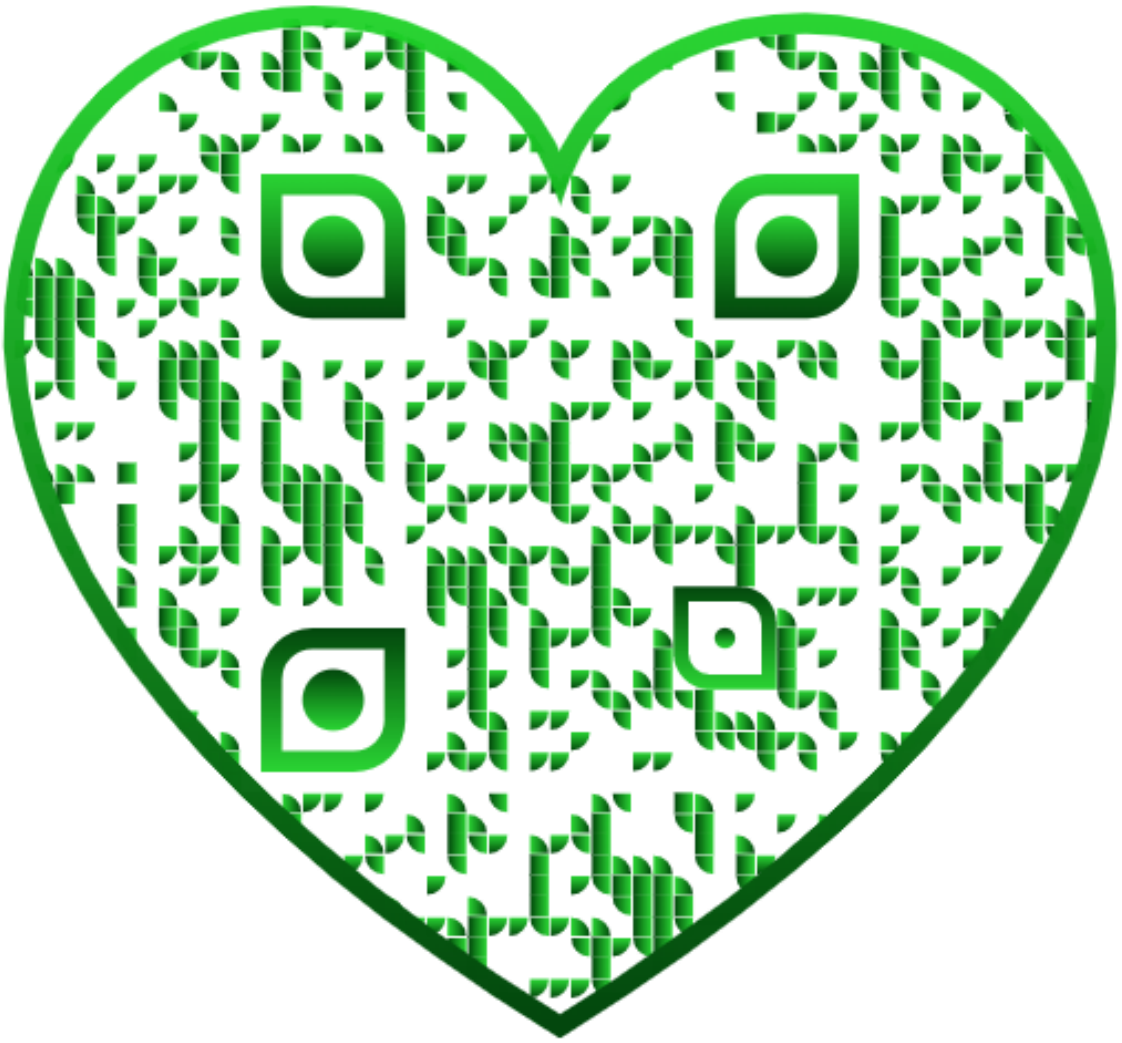
ANIMAL SYMBIOSIS

6 TIPS TO SPOT A DEEPFAKE

SPOTTED ZEBRA?

THE SCIENCE OF ANIMAL VARIATIONS

DO YOU BELIEVE IN GHOSTS?



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MISSION
Brainspace magazine produces intelligent and engaging articles for students ages 8 to 14 in a format that bridges the gap between print and digital technology to expand literacy and promote optimal learning.

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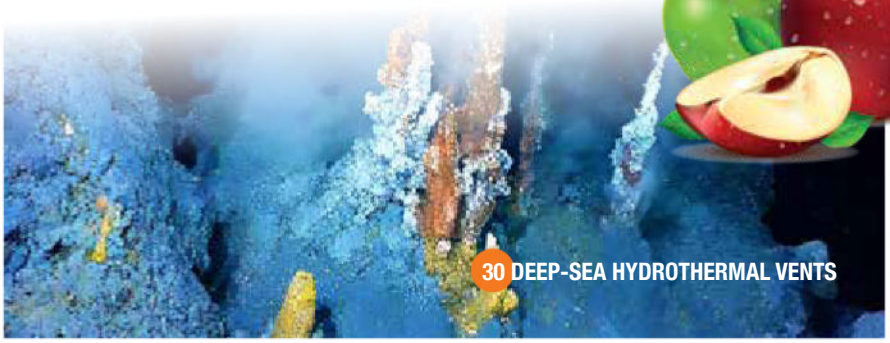

ROCK POWER! VS CLIMATE CHANGE

BY HOLLY BENNETT

Our planet is heating up because of increasing levels of greenhouse gases such as carbon dioxide in the atmosphere. Human activity has caused the increase. Burning fossil fuels such as oil, natural gas, and coal to run our furnaces, cars, and machinery produces carbon emissions. And when we cut down forests, we lose the trees that trap CO_2 and release oxygen. We need to drastically lower our carbon emissions, so that life on our planet can continue to thrive. We also need to get rid of some of the CO_2 that's already in our atmosphere.

The good news is there is lots of new technology being developed to help. We have clean sources of energy such as wind, solar, and geothermal power, and electric cars and buses that run without harmful emissions. But that's not all.

Two new technologies could be promising tools in our fight to stop global warming – and they rely on the natural power of rock!

SPEEDING UP NATURE

Rain combines with CO_2 in the atmosphere, bringing carbon down to the soil. As the carbon dioxide comes into contact with certain kinds of silica-rich rock, such as basalt, it gradually mineralizes and is permanently locked away in solid form. This process is called "rock weathering," and it already removes about 1 billion tonnes (1.1 billion US tons) of CO_2 from the atmosphere each year. But the process takes thousands of years – not nearly fast enough to reverse the climbing CO_2 levels in our atmosphere.

So what if we could speed that process up dramatically?

GRAPHIC BRYAN MIDDLETON

FAST FACT **Iceland leads the world in renewable energy use. 85 percent of its energy supply comes from hydroelectric, geothermal, and wind power.**

TURNING CO_2 INTO STONE

We know how to filter out CO_2 from industrial emissions. So far, the captured CO_2 has been stored underground. But there are concerns about that method. What happens if the CO_2 leaks out again? Could pressure from stored gas cause earthquakes? In Iceland, they have found a way to turn the captured CO_2 into stone!

A company called Carbfix is demonstrating how they can turn carbon into rock in just 2 years, instead of the thousands of years it normally takes. It works like this:

- The CO_2 is filtered out of emissions from a factory or power plant, or the air.
- The CO_2 is dissolved in water, creating something very much like soda water.
- The carbonated water is pumped deep underground into basalt rock.
- Metals in the rock react with the CO_2 in the water and turn it into stone.

(continued next page)

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This technology has been used at a geothermal power plant in Iceland for about 10 years and is currently being used in 3 other projects in the country. During this time, 95 percent of the injected CO_2 has been turned into rock within 2 years!

ENHANCED ROCK WEATHERING

This technology is exciting because it's pretty easy to implement. It uses the small bits that are left over when rock is cut in quarries or with regular farm spreaders. Silicate rock, such as basalt, is crushed into powder and spread on agricultural fields or tree-planting sites. Because so much more of the rock surface is exposed to weather, the weathering process is super-speeded up: in one trial, 50 percent of the carbon capture had occurred after only 1 year! As a bonus, the crushed rock also improves soil fertility and structure, leading to better crop yields. This process is currently being tried and studied in sites around the world, including the U.S., England, Kenya and India.

THE ROCKY ROAD TO "SCALING UP"

These strategies have exciting potential, but they also have drawbacks and unknowns that need to be understood before they are widely used. Research is needed, for example, to understand why enhanced rock weathering works much better on some soils than others, and to measure accurately how much carbon is actually removed.

WHAT QUESTIONS DO YOU HAVE ABOUT THESE NEW EARTH-FRIENDLY IDEAS?

SAND BATTERIES

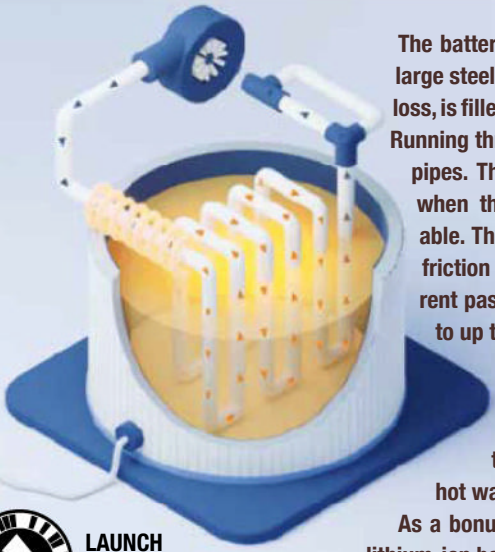
HOW COULD A BATTERY BE MADE OF SAND?

BY HOLLY BENNETT

Solar and wind generators only produce energy when it's sunny or windy. That energy needs to be stored somehow to keep it steadily available. Batteries have their own environmental problems, requiring mining of several minerals and a manufacturing process that produces waste and emissions. Plus, they are not that great at storing large amounts of energy for a long time.

You know what does hold energy – in the form of heat – for a long time? Sand. Yep, plain old sand. In Finland, engineers have developed large "batteries" made of sand! You can't power your phone with sand batteries, but they can help towns and industries reduce emissions and maintain a steady supply of heat from renewable energy.

HOW DOES IT WORK?



The battery itself is surprisingly simple. A large steel "silo," insulated to prevent heat loss, is filled with sand or a similar material. Running through the sand are heat transfer pipes. The sand is "charged" with heat when there is excess electricity available. The heat is generated through the friction created when an electrical current passes through the sand, heating it to up to 600°C (1,112°F).

The sand can store that heat for several weeks and even months. Then when it's needed, the heat can be delivered as air, hot water or steam.

As a bonus, sand batteries are safer than lithium-ion batteries, which are flammable.

LAUNCH ZAPPAR TO VIEW

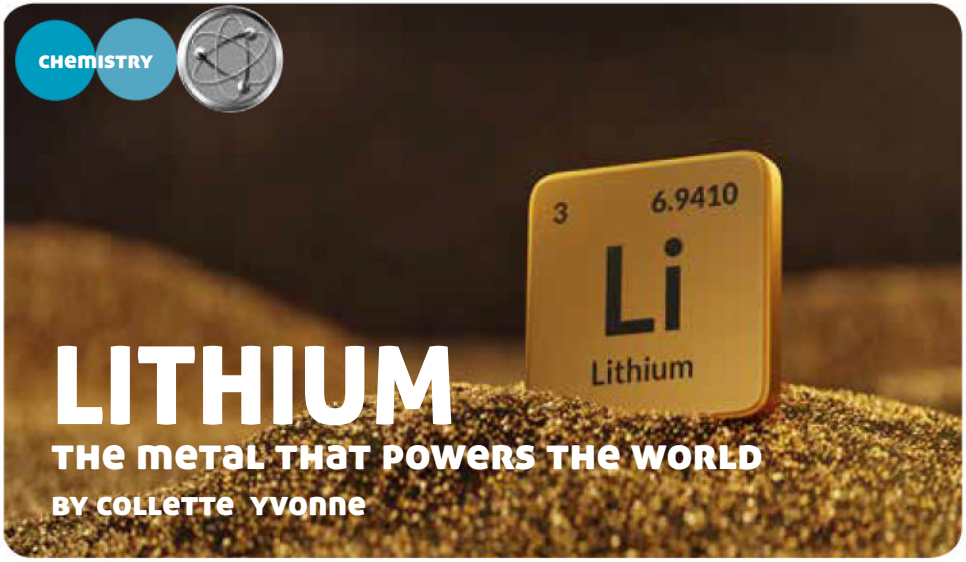
The largest sand battery

This year, the small Finnish town of Pornainen began using the world's largest sand battery. It's 13 metres (42.7 feet) high and 15 metres (49.2 feet) wide, and is expected to cut the town's heating emissions by nearly 70 percent.

Heat from the battery is distributed through Pornainen's district heating system to warm the town's buildings and swimming pools.

What is district heating?

District heating is quite common in Europe, but not here in North America. Instead of each building having its own furnace, heat is circulated to buildings (often as hot water) through underground pipes from a central plant. This is more efficient, reduces emissions, and can use a variety of energy sources, including waste heat from industrial processes. Pretty smart, eh?



LITHIUM

THE METAL THAT POWERS THE WORLD

BY COLLETTE YVONNE

HAVE YOU EVER WONDERED WHAT KEEPS YOUR SMARTPHONE, TABLET OR ELECTRIC CAR RUNNING ALL DAY? THE ANSWER IS LITHIUM – A SOFT, SILVERY METAL SO LIGHT IT CAN FLOAT ON WATER. LET'S HAVE A LOOK AT ONE OF THE MOST IMPORTANT ELEMENTS IN OUR MODERN WORLD.

A New Element

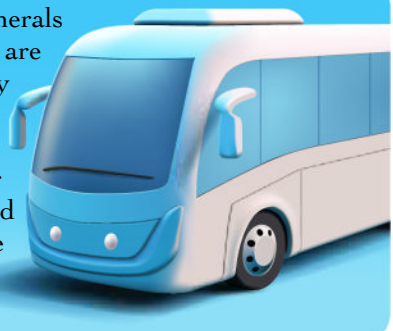
Lithium was discovered in 1817 when Swedish chemist Johan August Arfwedson found the metal hidden inside a rock called petalite. He named it lithium after the Greek word *lithos*, meaning stone. Scientists found the new element very interesting: lithium turns grey when it reacts with air and, when placed in water, it reacts dramatically. Tiny pieces fizz and spin on the water's surface. Lithium is highly explosive and even fine particles can easily ignite. Today, labs store lithium in mineral oil to block reactions with water and air.

Lithium's Weird History

In the late 1800s, many people thought lithium was a miracle cure. They flocked to health spas to bathe in "lithia" water, which is natural spring water rich in lithium salts. Then, in 1929, a businessman named Charles Leiper Grigg created a soda called 7UP®. It contained lithium in the form of lithium citrate. Our bodies absorb tiny amounts of lithium naturally from plants and water. But back then, no one knew that too much lithium could be dangerous. By 1948, the U.S. government banned the ingredient from soft drinks. 7UP is still popular today, but it no longer contains lithium citrate!

For a long time, lithium's uses were limited. But in the 1970s, scientists began experimenting with it as a material for batteries. Because lithium is so reactive, it showed great potential to generate electricity. They were correct.

Today, lithium is one of the most important minerals used in making batteries. These batteries are popular because they can store a lot of energy and last a long time. Lithium-ion batteries are rechargeable and are found in everything from toys and electric toothbrushes to bigger machines such as motorcycles, trucks and buses! Lithium is also used in non-rechargeable batteries that keep watches, smoke detectors and medical devices running for years.



Where Do We Find "White Gold"?

Lithium is sometimes called white gold because it's so valuable. Most of the world's lithium comes from salty underground brine lakes in South America and hard rock mines in Australia. China extracts lithium from both hard rock and brine pools, while Canada and the U.S. are opening mines in Quebec, Manitoba, California and Nevada. Some lithium even comes from volcanoes!

Are Lithium Batteries Recyclable?

Yes! But recycling lithium batteries can be tricky. Special factories safely extract lithium from old batteries so it can be reused. Always recycle your batteries properly. Never try to open a battery, as it could catch fire.

Fast Fact

Lithium's chemical symbol is Li, and its atomic number is 3, which means it's the third chemical element on the periodic table. Besides batteries and some medicines, lithium is popular in fireworks because it burns with a bright red flame.

SPOTTED ZEBRAS?!

Why animals can have strange colours and markings

BY HOLLY BENNETT

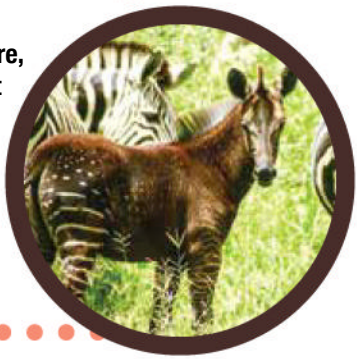
In 2019, a baby zebra was born in Kenya's Masai Mara National Reserve that was so oddly coloured it looked like a different species. The foal had a dark coat and white polka dots! Named Tira after the guide who first observed it, this cute little oddball baby soon became quite famous.

Tira's polka dots were caused by a rare genetic mutation called pseudomelanism. There are lots of other mutations that can cause specific variations in colouring in animals, leading red birds to turn yellow, lobsters to look blue, and black crows to sport a patch of white feathers. Here are a just a few:

ILLUSTRATIONS VALERIE PARIZEAU

What happened to Tira?

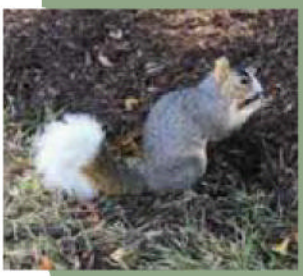
Scientists were not too hopeful about Tira's future, because herd animals with odd markings stand out from the crowd, making it easier for predators to focus on them. Babies are especially at risk. In late 2019, Tira's herd crossed into Tanzania, and for a long time there were no sightings. But in August 2021, he was "spotted" and photographed again – now a healthy-looking teenager.



Albinism

Albinism is a genetic mutation that prevents an animal from producing melanin – a pigment that gives skin, hair, fur or scales its colour. Albino animals are all white (usually – read on!). They have pink or red eyes, because the lack of melanin lets the colour of their blood show in their irises.

So when are albino animals not completely white? When some of their colouring comes from other pigments. Some birds and snakes, for example, get yellow, orange and red pigment from carotenoids, so these colours will still be there.



Leucism

Have you ever seen a crow with a patch of white feathers, or a gray squirrel with a white tip on its tail? It's likely due to a mutation called leucism. Leucism affects the way melanin is distributed – with normal amounts in some places, and none in others. Animals with leucism may be almost completely white, blotched with white, or just have a single white patch.

When under threat from a predator, birds can drop their tail feathers to escape capture. This is called a "fright molt" and these tail feathers occasionally grow back white!

Melanism

You might guess this one from the title! Instead of having no melanin, melanistic animals have a lot more than usual. One super-common example is the black squirrels we see all over city parks. They are actually gray squirrels with melanism. Black panthers are actually jaguars or leopards with melanism!

Pseudomelanism

So, back to Tira. Pseudomelanism, like leucism, affects how melanin is distributed – but there is no lack of melanin here! It results in spots, stripes, and/or an unusual density or placement of the usual markings.

CROSS FOX

PHOTO @KEEN.FEED

Variation is not always mutation

Some colour variations are normal. Red foxes, for example, are not always red! They can sometimes be silvery or nearly black, and 25 percent of them (called cross foxes) have a black stripe down the back and across the shoulders.

Other strange colouring can be caused by diet or environmental conditions. Flamingos get their bright pink colour from eating a certain kind of shrimp; if their diet changes, they fade. And in 2003, a polar bear in an Argentina zoo reacted to a medication it was given and turned (temporarily) purple!

PHOTO JEREMY BLACK

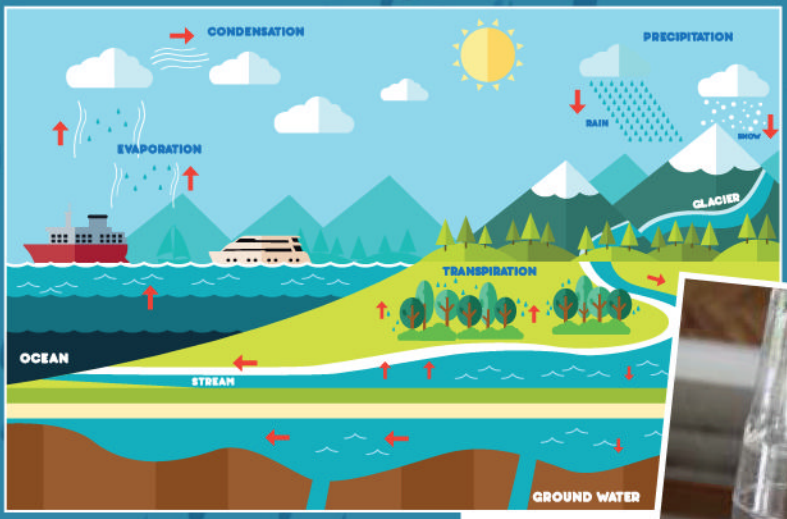
NATURAL HISTORY MUSEUM/SOLENT

There are many other rare mutations that can cause subtle or dramatic differences in an animal's appearance. One prevents yellow pigments eaten by birds from being converted to red – which can result in a bright yellow cardinal. Another turns lobsters blue! While these "genetic variations" don't usually bring any benefits to the animal, they help us appreciate the amazing variety and complexity of life on planet Earth.

THE WATER CYCLE

IT KEEPS OUR PLANET AND LIFE FORMS HEALTHY

BY GABRIELLE MIDDLETON



LAUNCH ZAPPER TO VIEW

PHOTO AND VIDEO GABRIELLE MIDDLETON

Have you bathed, watered a plant, cooked food, had a drink, washed dishes, gone swimming or done anything else related to water today? Think of the clean clothes you're wearing, the paper you wrote on, the electricity you used. All of these, and so many other parts of our daily lives, either directly or indirectly require water. And though it is limited in supply, water is everywhere: snow-capped mountains, lakes, streams, puddles, plants, the air around us and even in you! Your body is roughly 60% water! We can't live without it.

THE WATER CYCLE:

TRANSPIRATION: plants release water
EVAPORATION: water becomes vapour and rises
CONDENSATION: water is cooled and becomes a droplet
PRECIPITATION: water falls to the earth again

Try the experiment to create a tiny water cycle of your own. Note each of the stages of the water cycle as they happen.

MATERIALS

2 water glasses, boiling water, ice cube

METHOD

1. Fill a glass approximately two-thirds full of hot water.
2. Take another glass, flip it upside down, and place it on top of the glass with hot water.
3. Then place an ice cube on top of the upside-down cup. A cloud of condensation will begin to form at the top of the upside-down cup.

WHY DOES THIS HAPPEN?

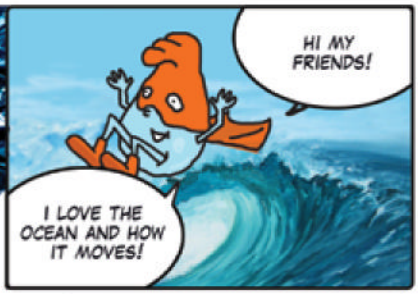
Hot water evaporates in the form of steam (invisible water vapour). The warm air rises but is trapped inside the upside-down glass. The ice cube on top creates cold air inside the glass. The warm vapour hits the cold surface, cools down, and turns into tiny drops of water – condensation. The droplets fall back into the bottom glass. The process continues!

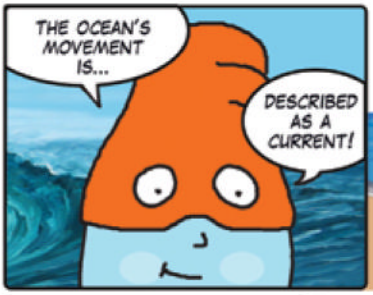
science

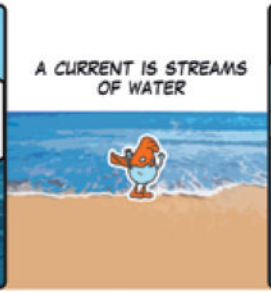
THE ADVENTURES OF Tallulah

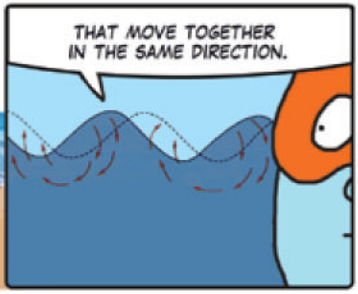
BY GALEXY

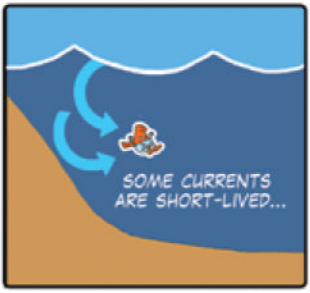
TALLULAH TELLS US ALL ABOUT CURRENTS

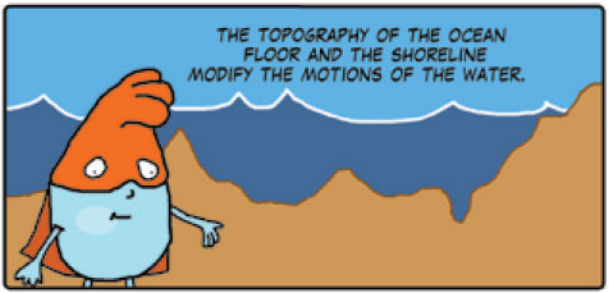


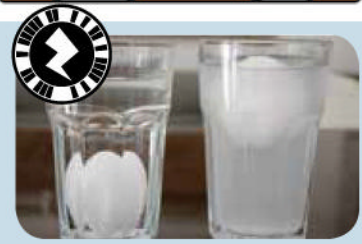








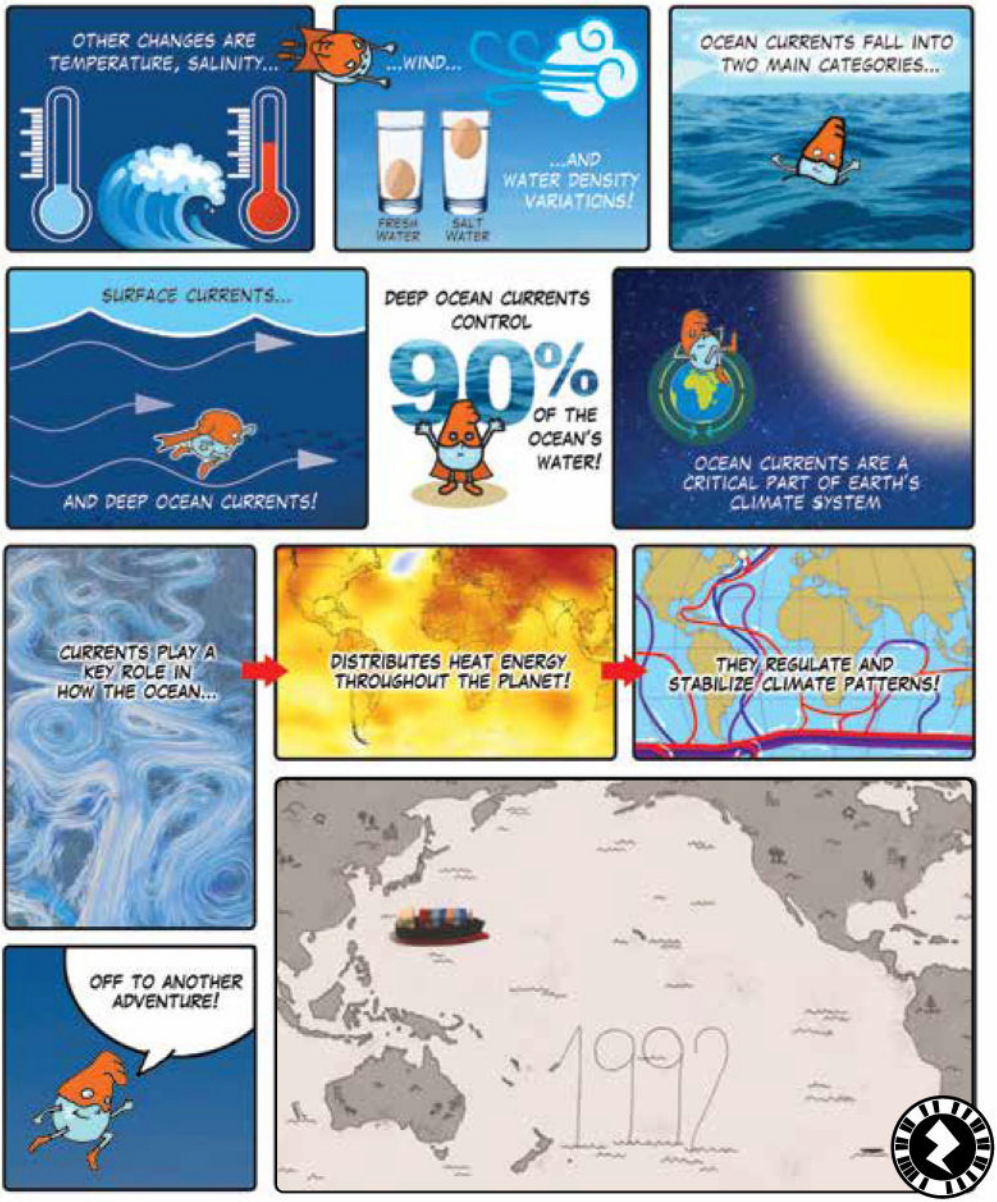




SINK OR FLOAT EGGS-PERIMENT

YOU WILL NEED

- 2 GLASSES FILLED WITH WATER
- 2 EGGS
- 2 TBSP SALT


OTHER CHANGES ARE TEMPERATURE, SALINITY...
...WIND...
...AND WATER DENSITY VARIATIONS!
FRESH WATER
SALT WATER
OCEAN CURRENTS FALL INTO TWO MAIN CATEGORIES...
SURFACE CURRENTS...
AND DEEP OCEAN CURRENTS!
DEEP OCEAN CURRENTS CONTROL
90%
OF THE OCEAN'S WATER!
OCEAN CURRENTS ARE A CRITICAL PART OF EARTH'S CLIMATE SYSTEM
CURRENTS PLAY A KEY ROLE IN HOW THE OCEAN...
DISTRIBUTES HEAT ENERGY THROUGHOUT THE PLANET!
THEY REGULATE AND STABILIZE CLIMATE PATTERNS!
OFF TO ANOTHER ADVENTURE!
1992

PROCESS

1. Add the salt to one of the glasses of water. Stir until the salt dissolves completely.
2. Gently place an egg in each of the glasses.
3. Observe.

Wash your hands after touching uncooked eggs. The shell may carry bacteria that can make you sick.

WHY DOES THIS HAPPEN?

The egg sinks in water because it has a greater density than the water does.

The egg floats in salt water because salt adds density to water, and the egg isn't as dense as salt water.

BY COLLETTE YVONNE

NATURE IS FULL OF ANIMALS THAT ARE JUST PLAIN WEIRD! MEET THREE OF THE STRANGEST CREATURES ON EARTH: BUBBLE-BLASTING SHRIMP, SUPER-STINKY BIRDS AND ONE PUNK-ROCK REPTILE WITH GREEN ALGAE HAIR AND A VERY UNUSUAL WAY TO BREATHE.

THE HOATZIN: THE STINKBIRD OF THE AMAZON

Deep in the steamy jungles of South America, near rivers in the Amazon and Orinoco basins, live the hoatzins (*Opisthocomus hoazin*). Don't stand too close, though. Often called "stinkbirds," hoatzins give off a stench like cow poop that helps keep predators away. While most birds can't digest leaves, hoatzins have stomachs that work a little like a cow's, using bacteria to ferment their leafy diet. These birds have a striking, prehistoric look with spiky crests, bright blue faces and red eyes. Baby hoatzins have two tiny claws on each wing, similar to *Archaeopteryx*, a bird from the dinosaur era. These claws help them climb trees before they learn to fly.

MARY RIVER TURTLES: AUSTRALIA'S MUD ROCKERS

Meet *Elusor macrurus*, an ancient turtle species with green "hair"! Found only in Queensland, Australia, these freshwater reptiles are nicknamed the punk turtle because they often grow long strands of green algae on their heads and shells that look like a spiky hairdo! The algae isn't just for style — it helps the turtle blend into muddy riverbeds. But the strangest part? These turtles can breathe through their butts! A special part inside their rear ends, called the cloaca, absorbs oxygen from the water. This means they can stay underwater for up to 3 days without coming up for air.

STRANGE BUT TRUE: NATURE'S WEIRDEST ANIMALS

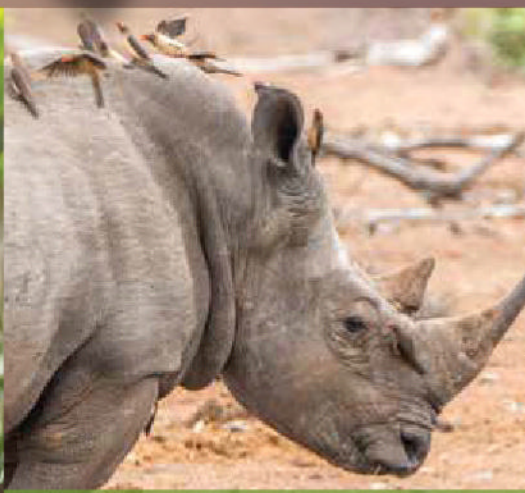
PISTOL SHRIMP: BUBBLE-BLASTING SUPER SNAPPERS

These tiny crustaceans (family *Alpheidae*), found in warm coastal waters around the world, are only 5–7 cm (2–3 inches) long, but they're among the loudest animals on Earth. When prey comes near, they send out a shock-wave that can stun or kill their target instantly. How does it work? First, they open an oversized claw to trap water, then snap it shut at 97 km/h (60 mph), firing a jet stream that creates what scientists call a cavitation bubble. When the bubble bursts, three amazing things happen at once: a 210-decibel snap (louder than a gunshot), a mini-hotspot estimated to reach 4,427°C (8,000°F) – hotter than lava! – and a tiny flash of light called sonoluminescence. They are so loud, a colony of pistol shrimp can even interfere with modern naval sonar.

BFF! ANIMAL PARTNERSHIPS IN THE WILD

by Collette Yvonne

LAUNCH ZAPPAR TO VIEW



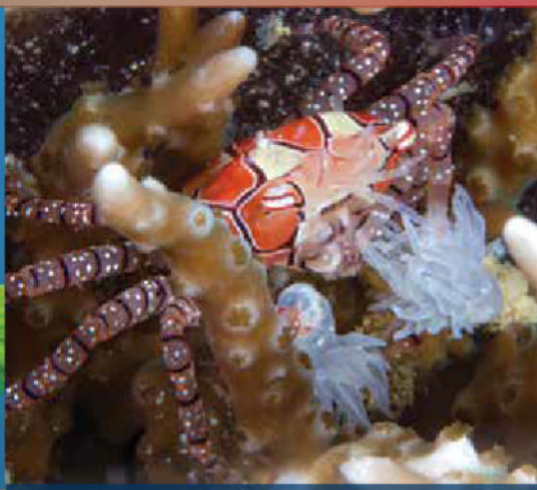
SLOTHS, MOTHS AND ALGAE

High up in the rainforests of Central and South America, three-toed sloths (*Bradypus variegatus*) love to hang out and eat leaves. Once a week, they climb down from the trees to poop on the ground! Predators lurk below, so why do they risk it? Scientists discovered a special partnership between sloths, moths (*Cryptoses* spp.) and algae. Moths lay their eggs in fresh sloth poop on the forest floor. The adult moths live in the hair of sloths. Their poop helps algae grow on the sloth's hair. The green algae provides camouflage for the sloth and a boost of nutrition when the sloth eats it!

OXPECKERS OR ACROBATS?

The acrobatic oxpecker (*Buphagus erythrorhynchus* and *Buphagus africanus*) and their rhinoceros buddies share a special partnership in the sunny savannas of sub-Saharan Africa. The birds cling to white rhinos (*Ceratotherium simum*) and black rhinos (*Diceros bicornis*) with their strong feet and sharp claws, often hanging upside down or sideways to pluck off ticks and parasites. Remarkably, the huge rhinos (which can weigh as much as a pickup truck!) don't seem to mind. As oxpeckers munch on insects, they get a nutritious meal while they help keep the rhinos' skin healthy. When danger nears, the birds hiss loudly, warning the rhinos of approaching predators.

When two very different animal species help each other survive and thrive, scientists call this teamwork mutualism. Read on to decide which partnership you think is the most clever: Team Pom-Pom? Team Clean? Team Acrobat?



A DAY AT THE SPA WITH CLEANER WRASSES

Imagine you're a giant oceanic manta ray (*Mobula birostris*) or a reef manta ray (*Mobula alfredi*) gliding through the warm sea. Your skin feels itchy from parasites and slime. What do you do? You head straight to your favourite coral reef where tiny striped fish called cleaner wrasses (*Labroides dimidiatus*) are waiting to help! Here, manta rays hover in place while the wrasses dart around, nibbling away dead skin, parasites and mucus. Groupers, eels, and even sharks wait their turn at the cleaning station too. The big predators do not eat the helpful cleaner wrasses. In return for the cleaning, the wrasses get a tasty meal.

NATURE'S CHEERLEADER: POM-POM CRABS

Boxer crabs (*Lybia edmondsoni* and *Lybia tessellata*), also called pom-pom crabs, live in the tropical waters of the Indo-Pacific region. These tiny crustaceans grow only about 13 mm (0.5 in) wide and have soft shells, so they must defend themselves – but in a surprising way. They carry venomous sea anemones (such as *Triactis producta*) on the tips of their claws, and wave them like pom-poms to scare off predators. Boxers also use the anemones to collect food particles, which they share with each other. If one anemone is stolen or lost, the crab can split the remaining one to make a new pair. Scientists aren't sure, but they think the crabs safely help the anemones reproduce by splitting them in two.

Bogong moths use Earth's magnetic field to find their way

BOGONG MOTHS LINE A CAVE WALL. SOURCE: CSIRO (CREATIVE COMMONS)

Following the stars

BY BEN MAYCOCK

The surface of the earth breaks and a small brown insect emerges. It shakes the soil from its wings and takes to the skies, joining billions of bugs just like it. Their upcoming journey will cover up to 11,000 kilometres (621 miles), a distance they have never travelled before, to arrive at a destination they have never visited.

Researchers have known for some time that Bogong moths use Earth's magnetic field to find their way. But the moth has also revealed it has another far more extraordinary trick up its sleeve: it can navigate using the stars. Scientists say it's the first known insect to do so.

WHILE SOME INSECTS, LIKE CERTAIN DUNG BEETLES, USE THE MILKY WAY FOR SHORT-RANGE ORIENTATION, BOGONG MOTHS ARE THE FIRST KNOWN TO USE THE STARS AS A TRUE COMPASS FOR LONG-DISTANCE MIGRATION.

Every spring, the very first thing Bogong moths do once they hatch is set off to the Australian Alps. The cool caves there offer them an escape from the summer heat, and they spend the hot season in a dormant state called estivation. In the fall, they return to their breeding grounds in Southeast Australia to mate and die. Each generation makes this trip for the first time without guidance from older moths.

ESTIVATION IS THE SUMMER EQUIVALENT OF WINTER HIBERNATION

Scientists discovered the Bogong's talent for astronomy by observing them in a special "flight simulator." When they removed the magnetic field, the moths were still able to navigate correctly under a realistic projection of the night sky. Rotating the starry image would cause the moths to adjust their flight path. Showing the moths a random pattern of stars, however, would confuse them.

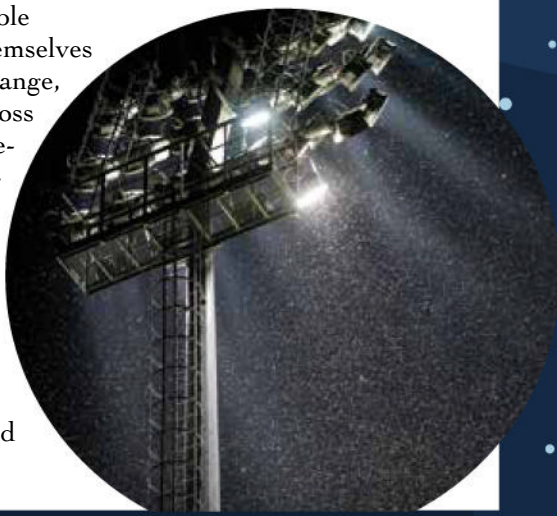
The Bogong moths' brains contain special visual neurons tuned to specific sky patterns. These cells respond most strongly when the moths are pointing in the direction of their migration. The patterns the moths likely rely on include the Milky Way, which may appear brighter to them than to humans.

The findings suggest the moths are born with two built-in compasses, one stellar and one magnetic. If it's cloudy and the stars are hidden, they can use Earth's magnetic field; if the magnetic signal is disrupted, they can follow the stars. Whatever nature throws at them, they will be able to stay on course during their twice-yearly migrations.

Despite the moths' remarkable natural abilities, they still find themselves struggling to survive. Climate change, drought, pesticides, and habitat loss have devastated the species. Between 2017 and 2019, their population fell by 99.5 percent and in 2021 the moths were listed as endangered.

Understanding how Bogong moths navigate could help conservation efforts. Light pollution, for example, can disorient them, causing swarms to become trapped in cities.

WEATHER FORECASTERS AT THE 2000 SUMMER OLYMPICS IN SYDNEY, AUSTRALIA, TRACKED WHAT THEY THOUGHT WAS A THREATENING STORM CLOUD, ONLY TO REALIZE IT WAS ACTUALLY A SWARM OF MILLIONS OF BOGONG MOTHS DRAWN TO THE STADIUM LIGHTS.



Don't Fall For

As technology advances, it is becoming increasingly difficult to distinguish between authentic online content and deepfakes (realistic-looking fake photos and videos that are generated or altered by artificial intelligence (AI).

While some deepfakes are harmless sources of entertainment, other AI-generated content is created to spread misinformation or to scam unsuspecting people. It is always important to proceed with caution when you're online.

How to spot deepfakes

Freaky fingers

AI is notoriously bad at depicting hands in photos and videos. Notice an extra finger where it shouldn't be or unnatural-looking skin tone? AI is likely the culprit.

Sloppy shadows & reflections

If the shadows on someone's face and body don't look natural or don't appear in places you would expect, you're likely looking at a deepfake. Is the person wearing eyeglasses? If so, zoom in closely and inspect the reflection in the eyeglass lenses to see if you can spot anything unusual.

ASTRONOMICAL ASSISTANCE

Scientists are conducting experiments to detect deepfakes with tools typically used to study galaxies. The tools analyze the distribution of reflected light to measure a galaxy's shape and symmetry.

The same approach can be applied when examining how light is reflected in a person's eyeballs. In a real photo, the reflections should be consistent in both the left and right eye. But in deepfakes, a close-up view of both eyes might reveal inconsistencies in the reflections.

This astronomical approach isn't completely foolproof (its success rate is about 70 percent), but it might prove to be a helpful tool in detecting deepfakes.

Deepfakes!

BY JAN KERTESZ

Lousy lip syncing

Does a speaker in a video move their mouth out of sync with the audio? Do their mouth movements look unnatural? When they speak, do they blink too much or not at all? Pay close attention to anything that looks fishy.

Too-smooth surfaces

Sometimes, content creators go a step too far and make their photos look overly perfect or slick. Extra-smooth skin or hair texture is a telltale sign of AI-manipulated content.

Awkward actions

While unrealistically smooth details can signal a deepfake, the opposite is also true. Choppy, inconsistent and weirdly contorted movement in online videos should raise a red flag.

Wonky wording

The background of a photo or video can provide helpful clues regarding the content's authenticity. Are street signs or billboards made up of gibberish or spelling that doesn't make sense? Typos and repetitive strings of letters are signs of AI manipulation.

BE A DEEPFAKE DETECTIVE

Don't automatically accept that the photo or video you see is authentic. Take steps to verify the origin of the content.

First, consider the source. If the content is a repost, check to see who originally posted it. Are they reputable and trustworthy?

If the content is going viral or is considered newsworthy, search to see if other reliable sources have posted the photo or video. Other sites may have already verified that the content is a deepfake.

Taking time to scrutinize suspicious content will help you avoid being duped by deepfakes.

Truly Real, Super Strange, Wondrous Marvels Or Not!

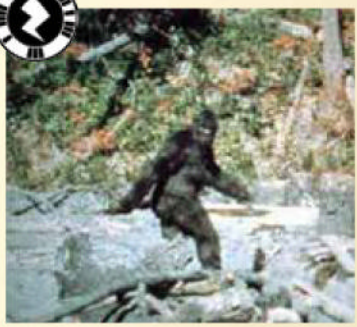
Watch out! You can't trust everything you see.

BY GALADRIEL WATSON

They sound too weird to be true: fairies in England, a giant in New York, a mermaid in Fiji. But thousands of people have been caught up in crazes and believed in beings like this. After all, they saw them themselves. Or did they?

LAUNCH ZAPPAR TO VIEW

I spy



There are many stories of large, hairy, ape-like creatures that walk on two very big feet. In North America, these beasts are known as Bigfoot or Sasquatch.

In 1958, huge, unexplained footprints were found in northern California – from Bigfoot? Then, in the same area in 1967, two men saw the creature itself lumbering into the woods. They quickly made a shaky, grainy film.

Sightings keep happening. In 2008, two men in the U.S. state of Georgia shared a photo of Bigfoot's dead body stuffed in a freezer. In 2016, a man flying a drone over Idaho filmed a strange, hairy beast running into a clump of trees.

So Bigfoot must exist, right? Not quite. The children of a Californian logger admitted their father had faked the 1958 footprints using a pair of carved wooden feet. The body in the freezer was a Halloween costume. And the thing running into the trees… it was a person in a costume too.

So far, though, no one has been able to tell if the 1967 video is real. Some people say it's a person in a costume, but others say the shape of the body and the way it moves aren't right. We may never know.

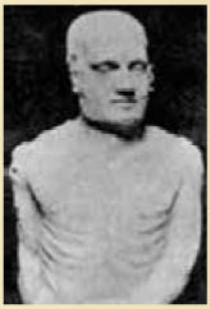
Fairies take flight

Shades of green, lavender and mauve. Cousins Elsie Wright, 16, and Frances Griffiths, 9, said those were the colours of the fairies they played with in the garden. Their parents were skeptical about these tales, so the girls grabbed a camera and came back with proof: a black-and-white photo of Frances surrounded by dancing fairies, followed by one of Elsie sitting with a tiptoeing gnome.

It was 1917, and the photos quickly became famous. It started when Elsie's mother showed them to a group that discussed fairies and other unexplained things. They started passing them around, which is how author Sir Arthur Conan Doyle saw them. The creator of Sherlock Holmes was a believer in strange phenomena, and he asked the girls for more proof. Shortly, they delivered three more photos, and he published the astounding images in a magazine. Since the girls lived near the village of Cottingley, England, the fairies became known as the Cottingley Fairies.

Lots of people thought the photos must be fake, but many others disagreed. Eventually, the fuss died down. It wasn't until the early 1980s that the cousins finally revealed that Elsie had drawn the fairies herself. To photograph them, they'd propped up the cutouts with hatpins.

A giant mystery



Bam! The man's shovel hit something hard. It was 1879, and he was on the grounds of a hotel near Taughannock Falls, New York, widening the path for carriages. He must have hit a rock. And then everyone saw what it was – the buried body of a seven-foot-tall, hard-as-a-rock man!

Soon, thousands of people came to view the petrified body of the "giant." The hotelkeeper put up a tent, and charged people 10 cents each to view it and sold photographs. Scientists took samples, but couldn't decide what it was.

Ten years earlier, another giant had been found nearby, in Cardiff, New York. The owner of that land and his cousin had also charged admission, and eventually sold the body to a group that took it on tour.

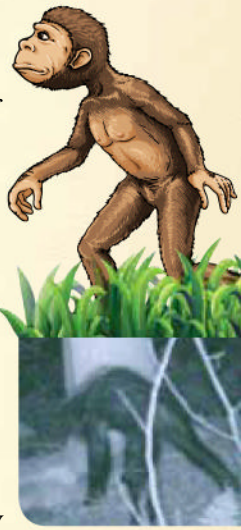
Unfortunately, spectators were paying their hard-earned cash for nothing. The Cardiff cousins soon admitted they'd had the man carved out of the mineral gypsum and had buried it themselves. In Taughannock, the hotelkeeper and a helper mixed eggs, beef blood, iron filings and cement, shaped it into a man, cooked it and buried it. In both instances, money was the main goal.

A splashy spectacle

The ads for the exhibit showed images of a beautiful mermaid. In reality, the mermaid's mummified body was hideous. Still, that didn't stop people from flocking to gawk at it. In those days – it was the 1840s – explorers were discovering all sorts of new animals, so had a mermaid been discovered too?

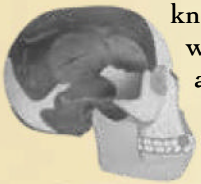
The main person promoting this mummy was Phineas Taylor Barnum. He became famous for his three-ring circus, but for now he was attracting crowds by displaying odd objects and unique people at his American Museum in New York City. The mermaid – he claimed – came from the Feejee Islands (now spelled Fiji), so it was called the Feejee Mermaid. There were many disputes about whether it was genuine, but Barnum revealed the truth in his autobiography. Right from the beginning, he'd known it wasn't a mermaid. Instead, someone in Japan had carefully sewn the upper half of a monkey to a fish tail, and the creation eventually ended up in Barnum's hands. To build interest, he sent letters to newspapers and introduced a phony scientist who swore the creature was real. Over the years, more mermaid mummies have turned up elsewhere – all of them just as fake!

Digging up the past



In 1912, amateur archaeologist Charles Dawson and Arthur Smith Woodward, a geology expert from England's Natural History Museum, announced they'd found the remains of an ancient skull that looked like a human-ape combo. The scientific community was abuzz. They thought this particular skull would be the proof that humans evolved from apes!

The skull came from a gravel pit near Dawson's home in Piltdown, England, so the ancient human came to be known as Piltdown Man. However, other fossils were popping up in other places around the world, and they didn't look quite the same as this one. Still, when Dawson and Woodward found bone fragments from a second Piltdown Man, the truth couldn't be denied…until 41 years later. By this time, bone-dating technology had improved. Turns out Piltdown Man wasn't 500,000 years old. He was only about 50,000 years old! Upon closer look, scientists discovered it was actually a collection of human and orangutan bits, all stained to look old. Scientists today think Dawson was the main forger, but did he work alone? So far, the skull of Piltdown Man isn't telling.



The sisters who could

"Count to 5," Mrs. Fox called out. In the bedroom, an invisible being knocked exactly 5 times. That's because Mrs. Fox's daughters – also gathered in this room in 1848 – were able to contact the dead. Word quickly spread about the eerie talents of Maggie, 14, and Kate, 11, who lived in Hydesville, New York. Folks from all around wanted to witness their supernatural skills. The sisters helped people speak to their dead loved ones. They put on performances in packed theatres. They travelled across the ocean and contacted British ghosts too.

Soon, many other "mediums" appeared, holding dimly lit séances to call forth spirits. In fact, speaking to the dead became so popular that a new religion emerged, called spiritualism. Spectators swore that what they witnessed was real – the bumps, the table tipping, the floating objects, the spirit shimmering in the corner.

They were wrong. 40 years after they'd started, the Fox sisters confessed. In their childhood home, they'd made otherworldly noises by thumping apples across the floor. They'd learned to crack their toes, knuckles and other joints – super loudly. Other mediums were caught faking things, too. All those ghosts of loved ones had been nothing but tricks.

The Science of SPOOKY

BY JOHN HOFFMAN

Why do many people believe in ghosts? There are many reasons, no doubt. Here are a few examples of scientific research that can help explain why people believe in things that seem impossible.

The unseen presence

People who talk about ghosts or hauntings often say they felt or sensed a nearby presence, even when they couldn't see it. Why might they feel that way? As Egon Spengler often said in *The Real Ghostbusters* cartoons, "Difficult to say." But it's clear that people's perceptions can be influenced by outside forces in ways that make them feel like something, or someone, is there. Mix that with imagination, emotion, and belief, and it's no wonder that many people believe in ghosts, haunted houses, and other supernatural things.

Most scientists agree that ghosts, haunted houses and other spooky things exist mostly in our imaginations. But even so, a surprising number of Canadians believe in ghosts.

In a 2023 poll, ***1 in 4*** Canadians said they had sensed a ghost presence nearby.

Another 2023 poll found that ***4 in 10*** Canadians believe in haunted houses.

Magnetic fields

Magnetic fields exist in all sorts of places. Some come from the Earth, and some are created by electrical devices such as televisions, computers, and even alarm clocks. Magnetic fields can affect the brain and body in various ways, including some we're not really aware of. Michael Persinger, a professor of psychology at Laurentian University in Sudbury, found that 80 percent of test subjects said they sensed an "unseen presence" when he applied a weak magnetic field over the right hemispheres of their brains, using a special helmet that he called "The God Helmet."

In a spooky experiment, Professor Olaf Blanke tricked people's brains into feeling like there was an unseen, ghostly presence in the room. Test subjects, who were blindfolded and wearing earplugs, moved their hands while attached to a robotic device. That device relayed signals to a robot arm, which was behind them. When the subjects moved their hands in a certain way, the robot arm poked their backs. When the robot arm's poke was in sync with the subject's movements, their brains could tell that they were causing the pokes. But when researchers delayed the timing of the poke so it was out of sync with the person's movements, people said it felt like someone else was touching them. Some said it felt like someone, or something (like a ghost), was in the room with them.

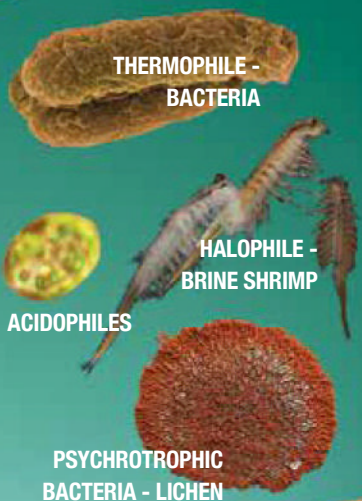
'Haunted' places

British psychology researcher Richard Wiseman (who started out as a professional magician) investigates the presences of magnetic fields at some locations that are widely believed to be haunted, such as Hampton Court Palace, a London castle that was built in 1515. He found that natural magnetic fields were more variable (they changed more often) in the environments of haunted places. Another researcher, Shane Rogers, says that the experiences people report in supposedly haunted places are very similar to the neurological and mental symptoms of people exposed to toxic molds or fungi. Many hauntings are reported in older buildings that would be more likely to have various kinds of mold and fungi.

Extremophiles

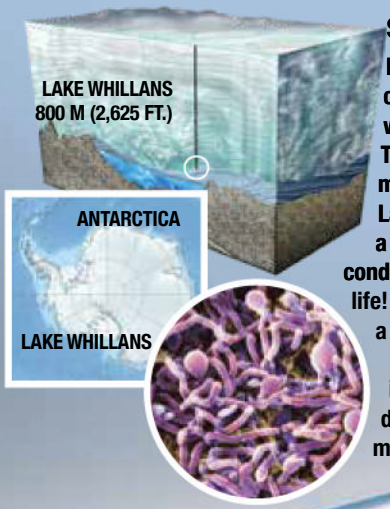
BY PASCALE BIDER

From tropical forests to frozen tundra, from the deep ocean to scorching deserts, planet Earth is covered by a huge variety of landscapes. All these environments present unique challenges to the animals that live there. Conditions like drought, heat, cold, and pollution can make it difficult for animals to survive. Some parts of the world have such extreme conditions that it may seem impossible for anything to live there… but life finds a way! Meet the extremophiles: creatures that live in planet Earth's most inhospitable places!



Amazing acidophiles

On the island of Hokkaido, in northern Japan, there is a region of volcanic hot springs known as the "Hell Valley." As its name might suggest, these springs are not the most comfortable place to live. The spring water is over 50°C (122°F) in some places, and extremely acidic in others. Exposure to these conditions for a long time would damage the bodies of most animals. This is not the case for two microbes, called *Picrophilus oshimae* and *Picrophilus torridus*. Both these organisms have made their home in the mud and water of the Hell Valley springs. The soil in which they live is even more acidic than battery acid! Because of this, scientists call these microbes "hyperacidophiles," meaning extreme acid lovers.



Surprising psychrophiles

Buried deep under the ice in Antarctica, there are pockets of liquid water called subglacial lakes. These frigid waters are home to a surprising variety of life forms! The creatures that live in them are called psychrophiles, meaning they thrive in the cold. One such subglacial lake is Lake Whillans. It lies 800 m (2,625 ft.) under the ice and has a temperature of -0.5°C (31°F). Despite these challenging conditions, the waters of Lake Whillans are teeming with life! In 2013, scientists drilled through the ice and collected a sample of water from the lake. They discovered that the frigid, salty water was inhabited by roughly 4,000 different types of microbes!

THE GREAT SALT LAKE,U.S. STATE OF UTAH

Hearty halophiles

As its name suggests, the Great Salt Lake in Utah, USA is extremely salty. In some places, the lake is almost 30% salt. That's 10 times saltier than the ocean! For most animals, living in such a salty environment would upset the delicate chemical balance of our bodies. However, the Great Salt Lake is home to many salt-loving species called halophiles. These halophiles include brine shrimp and brine flies, as well as algae and microbes. One of these algae, called *Dunaliella salina*, produces chemicals that sometimes make the Great Salt Lake look bright pink!

Thriving thermophiles

Deep down on the ocean floor, the world's hottest spots are called hydrothermal vents. These cracks in the crust of the Earth spew out incredibly hot jets of water. Some of them have a temperature of 400°C (752°F)! The microbes that live in these vents must withstand not only scalding heat, but also unbearable pressure and total darkness. Very few are up to the challenge! Among them is *Bythograea thermydron* or the "vent crab." This crab lives in large groups 2.7 km (1.7 mi) below the surface of the ocean. *Bythograea* and all heat-loving crabs are known as thermophiles.

By Noémy Mollaret - MNHN - Museum national d'Histoire naturelle (2020). The crustaceans collection (IU) of the Muséum national d'Histoire naturelle (MNHN - Paris). https://www.gbif.org/occurrence/440013006, CC BY 4.0, https://commons.wikimedia.org

Explorers of weird and wonderful creatures under the sea couldn't find a better neighbourhood than a thermal vent. This environment is home to some of the strangest, most fascinating creatures on the planet.

A thermal vent, or hydrothermal vent, is an opening on the seafloor that releases mineral-rich water that has been heated by the magma beneath the Earth's crust. These vents are usually found near tectonic plate boundaries where cold seawater seeps into the crust, heats up, and then rises back out.

Hydrothermal vents are among the most extreme environments on Earth. Water temperatures can exceed 400°C (752°F), the pressure is immense, and they often contain a punishing fluid mix of minerals and toxic chemicals.

So if you were to trick-or-treat down in the depths who might answer the door?

Meet the extremophiles.

THERMAL VENTS ARE SO FAR BELOW THE SURFACE OF THE OCEAN THAT MICRO-ORGANISMS MUST CONVERT CHEMICALS (CHEMOSYNTHESIS) INTO ENERGY.

Deep Sea Bizarre

THERMAL VENTS APPEAR AS EITHER "BLACK SMOKERS" (HOTTER DARKER PLUMES, RICH IN DARK MINERALS) OR "WHITE SMOKERS" (COOLER LIGHTER PLUMES, RICH IN LIGHTER MINERALS).

BY BEN MAYCOCK

Yeti Crab

This fuzzy-looking crab lives near hydrothermal vents and has white, hairy claws that look like they belong to a snow monster! It grows bacteria on its "fur" and then eats them for food—kind of like farming on its own arms.

Siboglinid Tube Worms

These worms can grow taller than a person and don't have mouths or stomachs! Instead, they survive by absorbing nutrients from bacteria living inside their bodies.

Sea Spiders

Sea spiders look like creepy crawlies from a Halloween story, with long legs, tiny teeth and odd noses. They eat bacteria that turn methane (greenhouse gas) into food. Females even shoot eggs from openings in their legs!

Aphyonidae aka Ghost Fish

This rare, ghostly fish was spotted alive for the first time by scientists in 2016. It's small, see-through and looks like jelly. It has no scales, tiny eyes and slips through the deep sea like a phantom.

Scaly-Foot Snail

This deep-sea snail has a shell like a knight's armor, coated in black iron sulfide from the vents. It even has metal scales on its foot, making it one of the toughest snails on Earth.

Holothuria aka Sea Cucumber

This squishy creature may look like an underwater earthworm, but it's actually a sea cucumber. It slowly creeps along the ocean floor, cleaning up as it goes like a natural vacuum.

Bigfin Squid

With arms that can stretch over 6 metres (20 ft.), this squid looks like the ocean's version of a daddy longlegs spider! Scientists think it might use those long limbs to build a trap and catch dinner.

Cooking and the course of human evolution

BY BEN MAYCOCK

A carrot becomes soft, a lobster turns bright red and an egg transforms from liquid to solid. Food changes in a number of different ways when it is cooked. But has the act of cooking changed humans as a species? A growing number of scientists think that is very likely.

Cooking is a human activity. No other animal on the planet cooks food like humans do. And every known human society throughout history has cooked food.

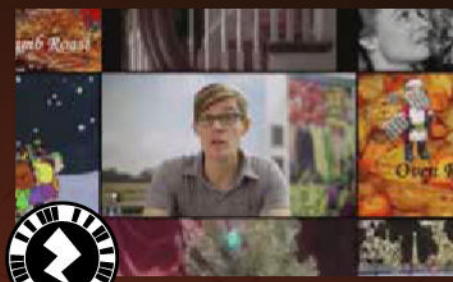
About 1.8 million years ago, *Homo erectus* arrived on the scene. They had bigger bodies and bigger brains than the humans that had come before them. And while bodies and brains had increased in size, their guts, jaws and teeth were all smaller.

How could this new human support its greater size if the parts of it responsible for converting food into energy were shrinking? Harvard anthropologist Richard Wrangham thinks the advent of cooking may hold the key to this remarkable stage in human evolution.

Fast fact: The human brain consumes a quarter of the body's energy.

Cooking presented *Homo erectus* with a highly efficient way of converting food into much more energy. Teeth and jaws didn't have to be as big and strong as they needed to be to chew raw food. Guts didn't have to be as big as they needed to be to store raw food as it slowly broke down in the stomach. Big bodies and more importantly big brains received the high amounts of energy they demand.

And cooking not only changed the human body into a highly efficient eating machine – it changed human society. Less time and energy spent eating meant early humans had the time (and those bigger brains) to develop tools and agriculture. Cooking also gave them a reason to gather together, which developed stronger relationships and a sense of home.



LAUNCH ZAPPAR TO VIEW

We take for granted the benefits of cooking food, but for early humans they were life-changing. Today, cooking means chopping, grinding and heating food to physically and chemically change it. This process makes food easier to eat and faster to digest. Cooked food also delivers more energy-giving calories to the human body than raw food does. For all of these reasons humans were able to extract much more energy from the food they consumed while using less energy to do so.

Chefs for chimps: Experiments with chimpanzees showed they preferred cooked food over raw food and had the patience to wait for it to be prepared. They would even save raw food if they thought it would be cooked for them later.

Fast fact: Our primate relatives spend half their days chewing tough raw food. Great apes, for example, spend 4 to 7 hours just chewing each day.

Why Do Apples Turn BROWN?

LET'S INVESTIGATE THE SCIENCE OF ENZYMATIC BROWNING

BY GABRIELLE MIDDLETON

Fall harvest is the best time for fresh food, and our favourite activity here at *Brainspace* is heading to the apple orchard!

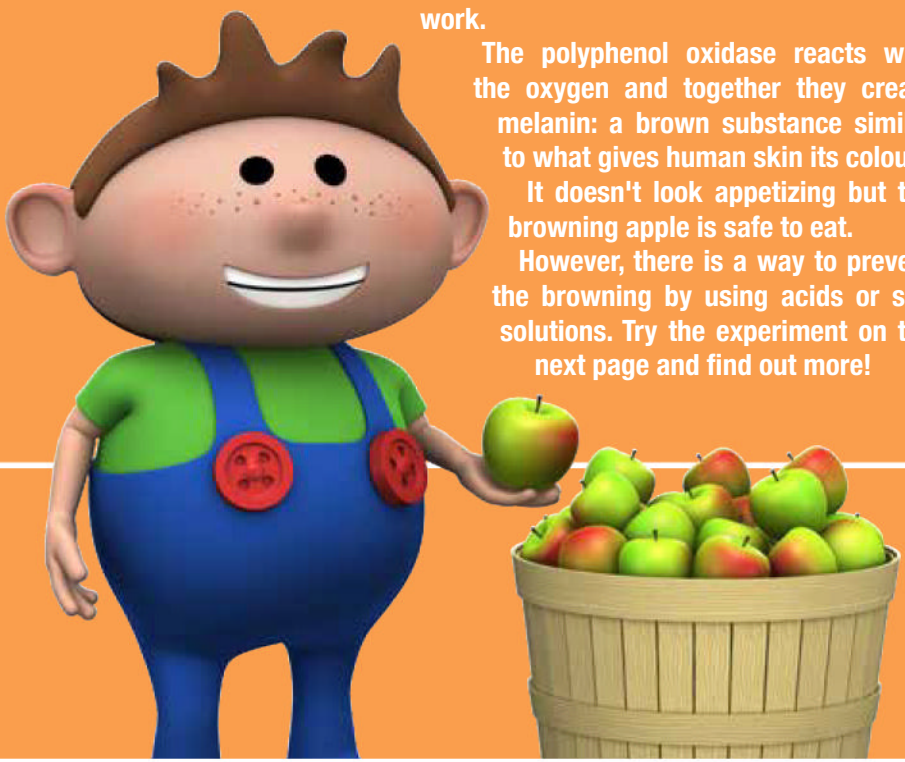
Apples are filled with different enzymes, so small that they can't be seen. One enzyme is called polyphenol oxidase and it contains 4 atoms of copper per molecule.

When you cut or bite into the apple, you break the skin and the inside of the apple touches the air. This lets oxygen from the air get in, which kick-starts the browning process. The polyphenol oxidase enzymes get to work.

The polyphenol oxidase reacts with the oxygen and together they create melanin: a brown substance similar to what gives human skin its colour.

It doesn't look appetizing but the browning apple is safe to eat.

However, there is a way to prevent the browning by using acids or salt solutions. Try the experiment on the next page and find out more!



LAUNCH ZAPPAR TO VIEW

YOU WILL NEED:

1	apple
1	paring knife
4	small bowls
1 cup	lemon juice
1 cup	water
1 cup	salt water (1 tbsp salt in 1 cup water)

METHOD:

1. Cut the apple into 4 slices (try to make the slices equal in size).
2. Prepare and label the bowls:
   Bowl 1: lemon juice
   Bowl 2: water
   Bowl 3: salt water
   Bowl 4: no liquid
3. Place each apple slice into a different bowl.
4. Let them soak for 5-10 minutes, then take them out and place them on a plate.
5. Set a timer and observe what happens to each slice over the next hour.
6. Record how fast each one browns and which treatment helped the most.

Why Does This Happen?

BOWL 1: Lemon is an acid that lowers the pH level on the apple skin. Since polyphenol oxidase is more reactive at higher pH levels, the apple doesn't brown as quickly.

BOWL 2: There is less oxygen in water than there is in open air. After soaking it in water, the apple turns brown but not as rapidly.

BOWL 3: Salt has chloride, which slows the apple's polyphenol oxidase enzyme from reacting with oxygen. The apple stays white for a long period of time.

BOWL 4: Untreated apple turns brown because nothing prevents the polyphenol oxidase from reacting with oxygen. Melanin is produced and the apple browns quickly.

WHAT'S BEHIND THE MASK?

By Holly Bennett

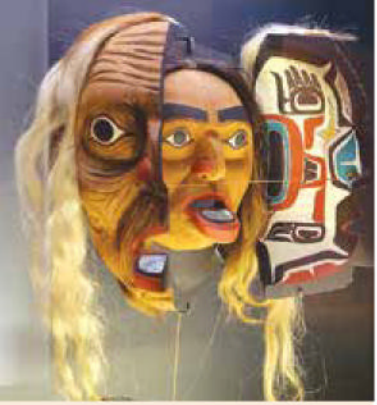
Have you ever worn a mask on Halloween? If so, you've joined in a tradition that dates back thousands of years. In fact, the oldest known mask is thought to be 9,000 years old! From ancient times, and in cultures around the world, masks have played many roles.

DISGUISE

Venice, Italy, is a city with a long tradition of mask-wearing, especially during "Carnevale." Venice's Carnevale was made official in 1296 and certainly existed in some form before that. During Carnevale, the focus was on partying, dancing and excess. People wore masks to disguise their identity, so they could shake off the strict social rules they normally lived under. Rich and poor, women and men, citizens and foreigners could mingle, and political criticism and parodies were allowed – but only during this time. Once Carnevale was over, the social order returned. Carnevale was banned at various times but has been revived in the present day, along with the traditional Carnevale masks.

RELIGION

Perhaps the most famous mask in the world is the mask that covered the mummy of Tutankhamun, who ruled Egypt for only 10 years (1333 BCE to 1323 BCE). Made with over 10 kg (22 lbs) of pure gold and inlaid with semi-precious stones, it is truly "fit for a king" – or in this case, pharaoh. As you can imagine, such precious materials were reserved for pharaohs and other royals; other nobles would have less elaborate funeral masks. Ancient Egyptians believed in life after death, but there was much that must be done to allow the dead soul to find its way to the afterworld. The masks were meant to strengthen the spirit of the deceased and ready them for their new life.



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CEREMONY AND STORYTELLING

The Indigenous Nations of the Northwest Coast carved and painted wooden masks that represented ancestors, supernatural beings, and animals. Each nation used the masks in different ways, but they were always special objects used in ceremonies such as the potlatch. The masks were often used to pass on sacred stories and teachings: costumed dancers wearing the masks would dramatize origin tales and legends for the people watching. Wearing the masks brought the dancers close to the spirit of the being they were depicting.

The coolest Northwest Coast masks are "transformation masks." They have moving parts that allow the dancer to open the outside of the mask, revealing a new character within. For example, an eagle's large beak might open to reveal a human face!

Today, these masks are still used in ceremonies. Indigenous artists also carve non-ceremonial masks as art objects to sell to collectors.

PROTECTION

The Black Death, or bubonic plague, struck Europe in the mid-1300s. People did not understand what caused it or how to treat it, and this first wave killed almost 1/3 of the population of Europe! The plague reappeared every few generations for centuries, though not as fiercely. In the 17th century, some doctors who treated plague patients tried to protect themselves by wearing a mask. The long, beaked mask made them look like a strange bird! The beak was stuffed with dried flowers and herbs. Back then, people believed the illness was carried on "bad air," and that the herbs would cleanse the air before they breathed it in.

They were on the right track. The mask would have offered some protection from germs carried by coughing and sneezing. Unfortunately, people didn't yet understand about germs or the importance of handwashing. Doctors went from patient to patient without washing their hands or their masks, so they likely infected themselves and others.

Use Zappar to watch a DIY on making a Plague Doctor mask. All you need is a cardboard box, glue, string and scissors.

THEATRE

Masks can be used to portray characters in theatre performances. There is a strong tradition of theatrical masks in Japanese Noh theatre, which is one of the world's oldest performing arts. Traditional Noh theatre combines drama, music and dance, and is still performed today.

The basic Noh theatre masks and characters were developed in the 1300s-1500s (an earlier version existed before that.) The masks portray characters in six categories: elders, demons, ghosts, men, women and the "old man." In the Noh tradition, most masks have a neutral expression. It is up to the actor to give the mask emotion, through their gestures and by tipping it up or down to look happier or sadder.

One of the best known Noh masks is the Hannya mask. Hannya is an angry female ghost. Her expression is a mix of jealousy, grief, grudge and sorrow. Horns and big teeth give her a demonic look.

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